

CALIBRATION STANDARD SPECIFICATION

FOR A

MODULAR UNIVERSAL COUNTER/TIMER

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PROCUREMENT PACKAGE

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MODULAR UNIVERSAL COUNTER/TIMER

1. SCOPE

1.1 Scope. This specification defines the mechanical, electrical, and electronic characteristics for a Modular Universal Counter/Timer. The equipment is intended to be used by Navy personnel in shipboard and shorebased laboratories to perform timing and counting measurements such as frequency period. For the purposes of this specification, the Modular Universal Counter/Timer shall be referred to as the MUCT.

2. APPLICABLE DOCUMENTS

2.1 Controlling Specifications. MIL-T-28800, "Military Specification, Test Equipment for use with Electrical and Electronic Equipment, General specification for," and all documents referenced therein of the issues in effect on the date of this solicitation shall form a part of this specification.

3. REQUIREMENTS

3.1 General. The MUCT shall conform to the Type II, Class 5, Style E requirements as specified in MIL-T-28800 for Navy shipboard and shorebased equipment as modified below. The use of material restricted for Navy use shall be governed by MIL-T-28800.

3.1.1 Design and Construction. The MUCT design and construction shall meet the requirements of MIL-T-28800 for Type II equipment.

3.1.2 Power Requirements. The MUCT shall operate from the power provided by a Tektronix model TM503 power module mainframe.

3.1.3 Dimensions and Weight. The MUCT shall be sized to fit in one slot of a Tektronix model TM503 power module mainframe. The weight shall not exceed 10 pounds.

3.1.4 Lithium Batteries. Per MIL-T-28800, lithium batteries are prohibited without prior authorization. A request for approval for the use of lithium batteries, including those encapsulated in integrated circuits, shall be submitted to the procuring activity at the time of submission of proposals. Approval shall apply only to the specific model proposed.

3.2 Environmental Requirements. The MUCT shall meet the environmental requirements for a Type II, Class 5, Style E equipment with the deviations specified below.

3.2.1 Temperature and Humidity. The MUCT shall meet the conditions below:

	<u>Temperature(°C)</u>	<u>Relative Humidity (%)</u>
Operating	10 to 30	95
	30 to 40	75
Non-operating	-40 to 70	Not Controlled

3.2.2 Electromagnetic Compatibility. The electromagnetic compatibility requirements of MIL-T-28800 are limited to the following areas: CE01, CE02, CS01, CS02 (0.05 to 100 MHz), CS06, RE01 (back panel search excluded), RE02 (14 kHz to 1 GHz), and RS03.

3.3 Reliability. Type II reliability requirements are as specified in MIL-T-28800.

3.3.1 Calibration Interval. The MUCT shall have an 85% or greater probability of remaining within tolerances of all specifications at the end of a 12 month period.

3.4 Maintainability. The MUCT shall meet the Type II maintainability requirements as specified in MIL-T-28800 except the lowest discrete component shall be defined as a replaceable assembly. Certification time shall not exceed 60 minutes.

3.5 Performance Requirements. The MUCT shall provide the following capability as specified below. Unless otherwise indicated, all specifications shall be met following a 30-minute warm-up period.

3.5.1 Channels. The MUCT shall have channel A and B inputs.

3.5.2 Input Frequency Range. The MUCT shall have a minimum input frequency range of 0 to 135 MHz, dc coupled and 10 Hz to 135 MHz, ac coupled.

3.5.3 Sensitivity. The MUCT shall meet the following minimum sensitivity requirements:

20 mV RMS sinewave to 100 MHz.  
40 mV RMS sinewave from 100 MHz to 135 MHz.  
115 mV p-p at minimum pulse width of 3 ns.

3.5.4 Attenuation. The MUCT shall have a selectable attenuation of 1X and 5X.

3.5.5 Dynamic Range. The MUCT shall have the input dynamic range from -3.2 to +3.2 V as follows:

X1:  $V_{in} \text{ p-p} \leq 3 \text{ V}$ . (For input signal rise ~~times~~  $\leq 5 \text{ ns}$ )

X5:  $V_{in} \text{ p-p} < 15 \text{ V}$ . (For input signal rise ~~times~~  $< 5 \text{ ns}$ )

3.5.6 Impedance. The MUCT shall have the input impedance of 1 M ohms paralleled by 30 pF.

3.5.7 Maximum Input Voltage. The MUCT shall have a maximum input voltages to channel A and B as follows:

1X:  $\leq 200$  V peak  $\leq 400$  V p-p from DC to 50 kHz,  
 $\leq 15$  V p-p at 135 MHz.

5X:  $\leq 200$  V peak  $\leq 400$  V p-p from DC to 5 MHz,  
 $\leq 25$  V p-p at 135 MHz.

3.5.8 Trigger Levels.

3.5.8.1 Manual Trigger Level. The manual trigger level of the MUCT shall be at least  $\pm 3.2$  V on the X1 input range and at ~~least~~ on the X5 input range.

3.5.8.2 Auto Trigger Sensitivity. The MUCT shall have the auto-trigger sensitivity of  $\leq 25$  mV p-p times attenuator ~~from 20 Hz to~~  
 $\geq 100$  MHz.

3.5.9 Independent Controls. The MUCT shall have independent controls for Slope $\pm$ ; Attenuation 1X/5X; Couple AC/DC; and Source Internal/External.

3.5.10 Shaped Outputs. The MUCT shall have outputs that provide a shaped replica of the internal signals being used for the measurement.

3.5.10.1 Shaped Output Amplitude. The shaped output amplitude of the MUCT shall be from 0  $\pm 0.3$  V from 50 ohms ground referenced source.

3.5.10.2 Shaped Output Risetime. The shaped output risetime of the MUCT shall be at least 3 ns.

3.5.11 Channel A Requirements. The MUCT shall meet the following channel A specifications.

3.5.11.1 Channel A Frequency Range. The MUCT shall have, as a minimum, a channel A frequency range of ~~1 Hz to~~ 135 MHz.

3.5.11.2 Channel A Frequency Resolution. The MUCT shall have a minimum channel A frequency resolution ~~LSD~~  $\pm 1.4 \times (\text{Trigger Jitter Error})/N \times (\text{Frequency Channel}^2.A)$

LSD: Least Significant Digit.

N: Number of Events Averaged.

3.5.11.3 Channel A Frequency Accuracy. The channel A frequency accuracy of the MUCT shall be a minimum of: ~~Resolution~~  $(\text{Timebase Error} \times \text{Frequency})$ .

3.5.12 Period A.

3.5.12.1 Period A Range. The MUCT shall have, as a minimum, a period A range of 7.40 ns to 3.05 hrs.

3.5.12.2 Period A Repetition Rate. The Period A repetition rate of MUCT shall be at least 135 MHz.

3.5.12.3 Period A Resolution. The MUCT shall have a minimum period A resolution of  $\pm \text{LSD} \pm 1.4 \times (\text{Trigger Jitter Error})/N$ .

3.5.12.4 Period A Accuracy. The period A accuracy of the MUCT shall be a minimum of  $\pm \text{Resolution} \pm (\text{Timebase Error} \times \text{Period A})$ .

### 3.5.13 Time A-B.

3.5.13.1 Time A-B Range. The MUCT shall have, as a minimum, a time A-B range of 15 ns to 3.05 hours.

3.5.13.2 Time A-B Resolution. The MUCT shall have a minimum time A-B resolution of  $\pm \text{LSD} \pm (\text{CH A Trigger Jitter Error} + \text{CH B Trigger Jitter Error})/N^{1/2}$ .

3.5.13.3 Time A-B Accuracy. The time A-B accuracy of the MUCT shall be a minimum of:  $\pm \text{Resolution} \pm (\text{Timebase Error} \times \text{Time A-B}) + (\text{CH B Slew Rate Error} - \text{CH A Slew Rate Error} \pm \text{Channel Delay Mismatch})$ .

3.5.13.4 Time A-B Channel Delay Mismatch. The time A-B channel delay mismatch of the MUCT shall not exceed 2 ns between front panel inputs.

3.5.13.5 Minimum Dead Time (Time B-A). The minimum dead time from stop to start (time B-A) of the MUCT shall be 15 ns.

### 3.5.14 Width A Requirements.

3.5.14.1 Width A Range. The MUCT shall have, as a minimum, a width A range of 15 ns to 3.05 hours.

3.5.14.2 Width A Resolution. The MUCT shall have a minimum width A resolution of  $\pm \text{LSD} \pm (\text{Start Trigger Jitter Error} + \text{Stop Trigger Jitter Error})/N^{1/2}$ .

3.5.14.3 Width A Accuracy. The width A accuracy of the MUCT shall be a minimum of:  $\pm \text{Resolution} \pm (\text{Timebase Error} \times \text{Width A}) + (\text{Stop Slew Rate Error} - \text{Start Slew Rate Error} \pm 5 \text{ ns})$ .

### 3.5.15 Time Manual.

3.5.15.1 Time Manual Range. The MUCT shall have, as a minimum, a time manual range of 0 to 3.05 hours.

3.5.15.2 Time Manual Resolution. The time manual resolution of the MUCT shall be  $\pm \text{LSD} (100 \text{ ms})$ .

3.5.15.3 Time Manual Accuracy. The time manual accuracy of the MUCT shall be a minimum of  $\pm \text{Resolution} \pm (\text{Timebase Error} \times \text{Time})$ .

### 3.5.16 Totalize A.

3.5.16.1 Totalize A Range. The MUCT shall have, as a minimum, a totalize A range of 0 to  $1.09 \times 10^{12}$  counts.

3.5.16.2 Totalize A Repetition Rate. The totalize A repetition rate of the MUCT shall be from 0 to at least 135 MHz.

### 3.5.17 Internal Timebase.

3.5.17.1 Aging Rate. The long term drift (aging rate) of the MUCT shall not exceed  $1 \times 10^{-6}$  per year.

3.5.17.2 Temperature Stability. The frequency stability of the MUCT shall not exceed  $5 \times 10^{-6}$  when operating in a temperature of  $10^{\circ}\text{C}$  to  $40^{\circ}\text{C}$ .

3.5.17.3 Timebase Setability. The MUCT timebase setability shall be  $1 \times 10^{-7}$  or better.

3.6 Operating Requirements. The MUCT shall provide the following capabilities.

3.6.1 Front Panel Control requirements. All modes and functions shall be operable using the front panel controls. The locations and labeling of indicators, controls, and switches shall provide for maximum clarity and easily understood operation without reference to tables, charts, or flow diagrams.

3.6.2 Front Panel Display. The MUCT's display shall have a minimum of 8 digits. The MUCT shall have indicators for units in MHz, kHz, ~~use Hz~~, nsec, msec, sec, gate open, and overflow.

3.6.2.1 Display Time. The MUCT shall have a minimum display time range of approximately 0.2 to 5 seconds and a hold feature.

3.6.3 Compatibility. The MUCT shall be compatible with Tektronix mainframe TM 500/TM 5000 series.

3.7 Manual. At least two copies of an operation and maintenance manual shall be provided. The manual shall meet the requirements of MIL-M-7298.

3.7.1 Calibration Procedure. The manual shall provide a MUCT calibration procedure in accordance with MIL-M-38793.